

3.3.7. Introduction to Advanced Inertial Navigation System Test Techniques

As mentioned in Chapter 1, only the most rudimentary form of the inertial navigation system test techniques are presented in this book. Chapter 1 details the reasons for this format; however, in many applications, more rigor, accuracy and documentation of results are required. Table IV outlines additional instrumentation and assets which are typically applied in these more advanced tests. The purpose of

this table is merely to emphasize the existence of these advanced techniques. Further, this list is not exhaustive. Many innovative uses of assets and instrumentation exist. It is hoped that the examples provided leave the reader with a taste of how the test can be made more rigorous through the judicious use of instrumentation. In application; the user must refer to the more advanced documents referenced in Chapter 1 or solicit help from more experienced testers.

Table IV: Additional Assets or Instrumentation for use in Advanced Inertial Navigation System Tests

Test	Additional Asset or Instrumentation	Purpose/Benefit
Preflight and Built-in-Tests.	Digital Recorder.	Typically records data from data bus on which navigation system under test passes the BIT results. Allows precise documentation of test results. Usually used in conjunction with fault insertion tests.
	Video recording of display.	Provides automatic recording of what the operator sees as a fault status is displayed.
Controls and Displays.	Video recording of display.	Allows automatic documentation of display problems as well as post-flight analysis and evaluation.
	Cockpit mock-ups, reconfigurable cockpits and virtual cockpits.	Typically used for in-depth ground tests of human factors and in iterative cockpit design.
	Digital recording of operator actions.	Can be used as a means of precisely recording operator selections to document noted problems and as a means of performing operator task analysis.
Initialization and Alignment.	Digital recording of navigation data bus to include all Inertial Navigation System (INS) outputs, alignment parameters and operator actions and inputs. Precisely surveyed alignment location and boresighted aircraft heading and orientation.	Entire alignment process is captured allowing isolation of poor alignment performance. Initialization process is recorded and correlated to operator selections. Final alignment results are compared to known alignment location and aircraft orientation.

Table IV: Additional Assets or Instrumentation for use in Advanced Inertial Navigation System Tests (Continued)

Test	Additional Asset or Instrumentation	Purpose/Benefit
Static Position Accuracy.	Digital recording of INS derived position and rates. Video recording of display. Precisely surveyed alignment location.	Digital position and rates are compared to the known static values. Display output to the operator is compared to the direct INS output.
Dynamic Non-maneuvering Position Accuracy.	Digital recording of aircraft dynamics, precise, time stamped space positioning data, INS derived position and rates, and operator actions. Video recording of the display.	The profile is flown without the necessity of surveyed point flyovers. Space positioning data and aircraft dynamics are continuously recorded and later compared to INS derived values. If derived from a range, the profile is often constrained geographically. Recently, Global Positioning System (GPS) data can be used with sufficient accuracy to avoid constricting the profile. Recorded aircraft dynamics are also examined to correlate maneuvering excursions with changes in INS drift rates. The display video is compared to the INS bus data to check for inconsistencies caused by the manipulation of the INS data and then its display.
Dynamic Maneuvering Position Accuracy.	Digital recording of aircraft dynamics, precise, time stamped space positioning data, INS derived position and rates, and operator actions. Video recording of the display.	Typically, precise space positioning data is derived from an instrumented range. Aircraft dynamics can be derived from either on or off the aircraft. The INS derived rates and position are compared directly with the time correlated data as the maneuvers are performed. The display video is used as above.
Dynamic Update Performance.	Digital recording of aircraft dynamics, precise, time stamped space positioning data, INS derived position and rates, and operator actions. Video recording of the display.	The data is used similarly to the Dynamic Non-maneuvering Position Accuracy test with the comparisons of position and rates performed after each update.

Table IV: Additional Assets or Instrumentation for use in Advanced Inertial Navigation System Tests (Continued)

Test	Additional Asset or Instrumentation	Purpose/Benefit
Mission Utility and Integration.	Digital recording of aircraft dynamics, precise, time stamped space positioning data, INS derived position and rates, and operator actions. Video recording of the display. Digital recording of all navigation data passed to other aircraft systems.	This test requires the largest amount of data to completely document the results. It is during this test that most of the unexpected problems are found. In anticipation of having to document these deficiencies, maximum instrumentation and range support are sometimes brought to bear in case unforeseen data are required in post-flight analysis.